Oct. 21, 1941. G. B. BANKS 2,259,511

MICROPHONE

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Fig. 1

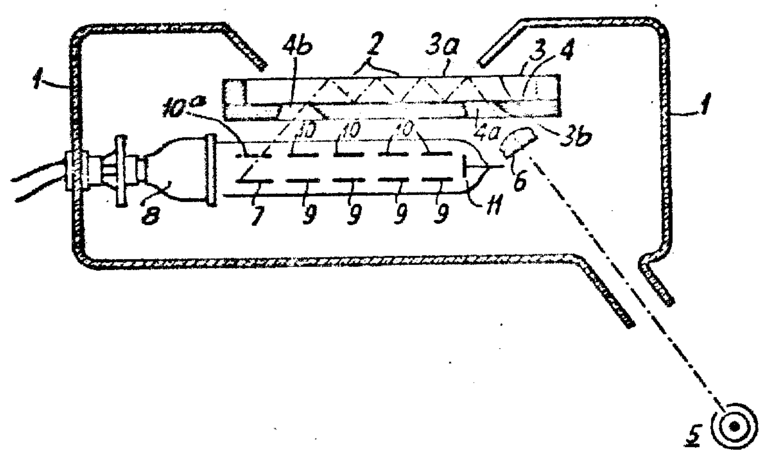
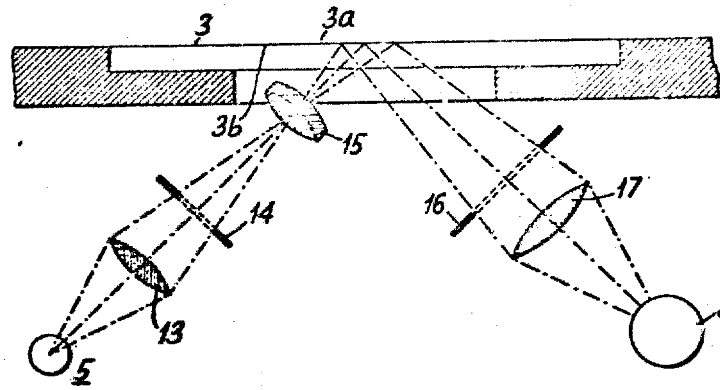


Fig. 2



INVENTOR
GEORGE BALDWIN BANKS
BY H. S. Grover
ATTORNEY

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MICROPHONE

George Baldwin Banks, Billericay, England, assignor to Radio Corporation of America, a corporation of Delaware

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3 Claims. (Cl. 179—138)

This invention relates to microphones. The term "microphone" is employed in this specification to mean a device for translating sound into electrical variations.

Microphones of very high fidelity are available nowadays but, in general, the high fidelity is obtained at the expense of sensitivity and more or less powerful valve amplifiers are necessary for use therewith. Accordingly the signal/noise ratio of a good quality microphone and associated amplifier installation is apt to be poor, especially for weak sounds, owing to the noise level due mainly to thermal agitation in the input circuit of the amplifier. The present invention seeks to meet this difficulty.

According to this invention a microphone comprises an electron discharge device (preferably an electron multiplier) having a photo-sensitive cathode, a source of light, means for projecting light from said source to said cathode after at least one reflection, means responsive to incident sound for moving the reflecting surface, and means interposed in the reflected light path and so arranged as to control, in dependence upon movements of said surface, the amount of light falling upon said cathode, sound signals being taken from the output of said discharge device. Preferably the light is reflected a plurality of times from the acoustically moved surface before reaching the cathode, so that an inertia-free "optical lever" effect is obtained, a small movement of said surface producing a large change in the light incident upon the cathode.

The invention is illustrated in the accompanying drawing which shows, schematically, two embodiments thereof.

Referring to Figure 1 which shows one form of michophone in accordance with the invention there is employed a box or container 1 with an opening 2 in one face and a thin, light, sheet diaphragm 3 of any convenient form, e. g. a metal ribbon, is disposed beneath this opening. The front face 3a of the diaphragm is exposed to incident sound and the rear face 3b is highly polished or plated so as to contribute an optical mirror. The diaphragm is suitably suspended or carried a predetermined short distance in front of a fixed second reflector 4 so that the two mirror surfaces are parallel to one another. A suitable slit-like source 5 of light and associated lens system 6 is arranged to project light through an aperture 4a near one end of the second reflector 4 on to the diaphragm-reflector 3 so that the light strikes said diaphragm-reflector at a predetermined angle, say 45°, to its general plane. Light is reflected from the diaphragm reflector to the second reflector and thence back to the diaphragm reflector and thence back to the second reflector . . . and so on, for a predetermined number of reflections so that the light path between the two reflectors is of zig-zag form. The light path is represented conventionally by a chain line. Light finally reflected from the diaphragm-reflector 3 is brought to a focus on one edge of a second slit-like aperture 4b near the other end of the second reflector 4 but some passes through to the photo-electric cathode 7 of an electron multiplier tube 8. It is arranged that, in the static condition, about half the light passes onto the multiplier cathode 7. It will be seen that acoustic vibration of the diaphragm-reflector will cause variation of the light incident on the photo-cathode of the multiplier. For example, if the diaphragm-reflector moves through a distance d the lateral movement of the light image at the focus will be (assuming 45° as the angle of incidence of light) nd where n is the number of reflections of the light in its passage thereto. In practice n can be as high as 20 and a reasonably sharp focus still be obtained. The electron multiplier 8 which is preferably mounted inside the box, may be of any known type, e. g. it may be as shown of the type comprising a photo-cathode 7 and a plurality of secondary emitter electrodes 9 arranged in one plane, a plurality of field electrodes 10, and a single meshed electrode 10a are arranged in a second parallel plane and opposite the cathode and secondary emitter electrodes, and an output electrode 11 mounted at one end between the two parallel planes and at right angles thereto. The field electrode 10a opposite the cathode 7 should be light permeable—e. g. of mesh form—and the usual magnetic field is applied, e. g. by means of an electro- or permanent magnet structure (not shown). The microphone output is, of course, taken from the output electrode circuit of the multiplier through a suitable coupling device such as a transformer (not shown).

In the modification shown in Figure 2 light from a source is passed via a condenser lens system 13 on to a first transparent optical grating 14 and thence via a lens 15 and diaphragm reflector 3 to a second transparent optical grating 16, an image of the first grating 14 being thrown on to the second grating 16. Light passed through the second grating 16 is passed via a collector lens system 17 on to the photo-sensitive cathode of an electron multiplier represented at 8. The respective dimensions of the gratings depend on the optical magnification of the system. If this is unity the gratings are identical. The gratings consist of alternate opaque and translucent "bars" and the arrangement is such that in the condition of rest, i. e. in the absence of incident sound upon the diaphragm 3 the image of the first grating is displaced by one half "bar" with respect to the second grating so that the second grating passes one half the amount of light it would pass were the first grating removed. On displacement of the diaphragm 3 by applied sound the image of the first grating moves with respect to the second grating so that the amount of light passed to the tube 8 is correspondingly varied. Optical gratings with many thousands of lines or "bars" per inch are available so that great sensitivity can be obtained. If desired, the light between the gratings may be subjected to a plurality of reflections and not merely once as shown in Figure 2.

What is claimed is:

1. A microphone comprising in combination a casing member having a large and a small aperture therein, a pair of reflecting surfaces located near said large aperture in said casing, means for projecting a light beam on one of said surfaces through the small aperture of said casing, the other one of said surfaces having a plurality of apertures therein, said surfaces being positioned within said casing so that said beam is reflected from one surface to the other and back a plurality of times, an electron discharge device of the electron multiplier type supported within said casing, said electron discharge device having an input electrode positioned in the path of the light beam as it leaves the reflecting surfaces and passes through one of said apertures, said device having an output electrode from which electrical charges may be taken outside of said casing, and means responsive to sound waves for moving at least one of said reflecting surfaces to thereby alter the path of said light beam and the amount of light reaching said input electrode.

2. A microphone comprising in combination a casing member having a large and a small aperture therein, a pair of reflecting surfaces located near said large aperture in said casing, a metallic ribbon interposed between the large casing aperture and one of said reflecting surfaces, means for projecting a light beam on one of said surfaces through the small aperture of said casing, the other one of said surfaces having a plurality of apertures therein, said surfaces being positioned within said casing so that said beam is reflected from one surface to the other and back a plurality of times, an electron discharge device of the electron multiplier type supported within said casing, said electron discharge device having an input electrode positioned in the path of the light beam as it leaves the reflecting surfaces and passes through one of said apertures, said device having an output electrode from which electrical charges may be taken outside of said casing, and means responsive to sound waves for moving at least one of said reflecting surfaces to thereby alter the path of said light beam and the amount of light reaching said input electrode.

3. A microphone comprising a casing member having a large aperture in the front portion and a small aperture in the rear portion thereof, a pair of reflecting surfaces located near said large aperture of said casing, a lens interposed between said small aperture and one of said reflecting surfaces, means for projecting a light beam through said aperture and said lens and onto one of said surfaces, the other one of said surfaces having a plurality of apertures therein, said surfaces being positioned within said casing so that said beam is reflected from one surface to the other and back a plurality of times, an electron discharge device of the electron multiplier type supported within said casing, said electron discharge device having an input electrode positioned in the path of the light beam as it leaves the reflecting surfaces and passes through one of said apertures, said device having an output electrode from which electrical charges may be taken outside of said casing, and means responsive to sound waves for moving at least one of said reflecting surfaces to thereby alter the path of said light beam and the amount of light reaching said input electrode.

GEORGE BALDWIN BANKS.